

Application No. 09/344,629

Please amend the above-identified patent application as follows:

IN THE CLAIMS:

Claims 1-2 (Canceled)

~~1~~ 3. (Previously Presented) A liquid crystal display apparatus comprising:

a liquid crystal display panel having a predetermined display characteristic;

a luminescent unit located adjacent to the liquid crystal display panel, wherein the luminescent unit includes a light collector, which collects ambient light, and a light source,

5 wherein the collected ambient light is used as a backlight of the liquid crystal display panel;

a light receiving device substantially countering an optical path of the ambient light collected by the light collector, wherein the light collector illuminates the rear surface of the liquid crystal display panel, and the light receiving device detects the amount of collected ambient light; and

10 a control circuit electrically connected to the liquid crystal display panel and the light receiving device, wherein the control circuit varies the predetermined display characteristic in accordance with the amount of the detected ambient light, wherein the predetermined display characteristic includes transmittance, the control circuit changing a minimum transmittance in accordance with the amount of collected ambient light, and wherein the

15 liquid crystal display panel includes electrodes to which a voltage of a predetermined range is applied, wherein the control circuit shifts the predetermined voltage range in accordance

with the amount of collected ambient light to thereby change the minimum transmittance,
wherein the liquid crystal display panel includes:

first and second substrates opposing to each other;

20 a liquid crystal layer arranged between the first and second substrates; and

a sealed portion for sealing the liquid crystal layer and defining a peripheral area and
a display area of the liquid crystal display panel, wherein the light receiving device is formed
on one of the facing surfaces of the first and second substrates in the peripheral area and is
formed between the first and second substrates.

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2 ~~4~~ (Original) The apparatus according to claim ~~2~~¹, wherein the liquid crystal display
panel is operated in a normally white mode, and wherein the control circuit shifts the
predetermined voltage range to a high voltage range in order to decrease the minimum
transmittance when the amount of collected ambient light is equal to or greater than a
5 predetermined value.

3 ~~5~~ (Original) The apparatus according to claim ~~2~~¹, wherein the liquid crystal display
panel is operated in a normally black mode, and wherein the control circuit shifts the
predetermined voltage range to a low voltage range in order to decrease the minimum
transmittance when the amount of collected ambient light is equal to or greater than a
5 predetermined value.

6. (Canceled).

4 7. (Previously Presented) A liquid crystal display apparatus comprising:

a liquid crystal display panel having a predetermined display characteristic;

a luminescent unit located adjacent to the liquid crystal display panel, wherein the luminescent unit includes a light collector, which collects ambient light, and a light source,
5 wherein the collected ambient light is used as a backlight of the liquid crystal display panel;

a light receiving device substantially countering an optical path of the ambient light collected by the light collector, wherein the light collector illuminates the rear surface of the liquid crystal display panel, and the light receiving device detects the amount of collected ambient light; and

10 a control circuit electrically connected to the liquid crystal display panel and the light receiving device, wherein the control circuit varies the predetermined display characteristic in accordance with the amount of the detected ambient light, wherein the predetermined display characteristic includes contrast ratio, the control circuit adjusting the contrast ratio of the liquid crystal display panel in accordance with the amount of collected ambient light,
15 and wherein the liquid crystal display panel includes electrodes to which a voltage of a predetermined range is applied, and wherein the control circuit narrows the predetermined voltage range in order to decrease the contrast ratio when the amount of collected ambient light is equal to or greater than a predetermined value, wherein the liquid crystal display panel includes:

20 first and second substrates opposing to each other;
a liquid crystal layer arranged between the first and second substrates; and
a sealed portion for sealing the liquid crystal layer and defining a peripheral area and
a display area of the liquid crystal display panel, wherein the light receiving device
is formed on one of the facing surfaces of the first and second substrates in the
25 peripheral area and is formed between the first and second substrates.

6 8. (Previously Presented) The apparatus according to claim 5, wherein the control
circuit is connected to the light source, the control circuit turning off the light source when
the amount of collected ambient light is equal to or greater than a predetermined value and
turning on the light source when the amount of collected ambient light is less than the
5 predetermined value.

5 9. (Previously Presented) A liquid crystal display apparatus comprising:
a liquid crystal display panel having a predetermined display characteristic;
a luminescent unit located adjacent to the liquid crystal display panel, wherein the
luminescent unit includes a light collector, which collects ambient light, and a light source,
5 wherein the collected ambient light is used as a backlight of the liquid crystal display panel;
a light receiving device substantially countering the ambient light directed toward the
light collector to detect the amount of ambient light collected by the light collector; and

a control circuit electrically connected to the liquid crystal display panel and the light receiving device, wherein the control circuit varies the predetermined display characteristic in accordance with the amount of the detected ambient light, wherein the predetermined display characteristic includes transmittance, the control circuit changing a minimum transmittance in accordance with the amount of collected ambient light, and, wherein the luminescent unit includes a cover that moves between an open and closed position to selectively cover the light collector, and wherein the apparatus includes a cover driving apparatus connected to the control circuit to move the cover between the open and closed positions and the predetermined display characteristic includes opening and closing of the cover.

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10. (Original) The apparatus according to claim ⁵~~9~~, wherein the control circuit controls the cover driving apparatus such that the cover moves to the open position to expose the light collector when the amount of collected light becomes equal to or greater than a predetermined value and moves to the closed position to cover the light collector when the amount of collected ambient light becomes smaller than a predetermined value.

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11. (Original) The apparatus according to claim ⁵~~9~~, wherein the control circuit is connected to the light source, and wherein the control circuit controls the light source and the cover driving apparatus such that the light source is turned on and the cover is closed when the amount of collected ambient light is equal to or smaller than a first predetermined

- 5 value, the cover is opened when the amount of collected ambient light exceeds the first predetermined value, and the light source is turned off when the amount of collected ambient light exceeds a second predetermined value, which is greater than the first predetermined value.

9 ~~12~~⁸ (Original) The apparatus according to claim ~~11~~⁸, wherein the predetermined display characteristic includes contrast ratio and transmittance, and wherein the control circuit decreases the contrast ratio and the minimum transmittance when the amount of collected ambient light exceeds a third predetermined value, which is greater than the second predetermined value.

13 - 15 (canceled).

10 ~~16~~ (Previously Presented) A liquid crystal display apparatus comprising:
a liquid crystal display panel having a predetermined display characteristic;
a luminescent unit arranged adjacent to the liquid crystal display panel for providing light to the display panel to illuminate the display panel, wherein the
5 luminescent unit includes a light collector, which collects ambient light, and a light source, wherein the collected ambient light is used as a backlight of the liquid crystal display panel;

a light receiving device substantially countering an optical path of the ambient light collected by the light collector, wherein the light collector illuminates the rear surface of the liquid crystal display panel, and the light receiving device generates a light amount signal corresponding to the amount of collected ambient light; and

a control circuit electrically connected to the liquid crystal display panel and the light receiving device, wherein the control circuit varies the predetermined display characteristic in accordance with the light amount signal, wherein the liquid crystal display panel includes:

first and second substrates opposing to each other;

a liquid crystal layer arranged between the first and second substrates; and

a sealed portion for sealing the liquid crystal layer and defining a peripheral area and a display area of the liquid crystal display panel, wherein the light receiving device is formed on one of the facing surfaces of the first and second substrates in the peripheral area and is arranged between the first and second substrates.

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~~17.~~ (Previously Presented) A liquid crystal display apparatus comprising:

a liquid crystal display panel having a predetermined display characteristic;

a luminescent unit arranged adjacent to the liquid crystal display panel for providing light to the display panel to illuminate the display panel, wherein the luminescent unit includes a light collector, which collects ambient light, and a light

source, wherein the collected ambient light is used as a backlight of the liquid crystal display panel;

a light receiving device substantially countering an optical path of the ambient light collected by the light collector, wherein the light collector illuminates the rear surface of the liquid crystal display panel, and the light receiving device generates a light amount signal corresponding to the amount of collected ambient light; and

a control circuit electrically connected to the liquid crystal display panel and the light receiving device, wherein the control circuit varies the predetermined display characteristic in accordance with the light amount signal, wherein the liquid crystal display panel includes a pair of substrates, and wherein the light receiving device is arranged facing the luminescent unit on one of the substrates and adjacent to the display area of the liquid crystal display panel, wherein the liquid crystal display panel includes:

first and second substrates opposing to each other;

a liquid crystal layer arranged between the first and second substrates; and

a sealed portion for sealing the liquid crystal layer and defining a peripheral area and a display area of the liquid crystal display panel, wherein the light receiving device is formed on one of the facing surfaces of the first and second substrates in the peripheral area and is formed between the first and second substrates.

~~11~~ ¹⁰ 18. (Previously Presented) The apparatus according to claim ~~16~~, wherein the predetermined display characteristic includes transmittance, the control circuit changing the minimum transmittance, in accordance with the light amount signal.

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~~12~~ ¹⁰ 19. (Previously Presented) The apparatus according to claim ~~16~~, wherein the predetermined display characteristic includes contrast ratio, the control circuit changing the contrast ratio in accordance with the light amount signal.

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20 - 21. (Canceled).

~~16~~ 22. (Previously Presented) A liquid crystal display apparatus comprising:

a liquid crystal display panel for displaying an image having a predetermined contrast ratio and brightness;

5 a luminescent unit arranged adjacent to the liquid crystal display panel, wherein the luminescent unit includes a light collector, which collects ambient light, a light source, and a cover, which opens and closes to selectively cover the light collector, wherein the collected ambient light is used as a backlight of the liquid crystal display panel;

a cover driving apparatus for opening and closing the cover;

10 a light receiving device substantially countering the ambient light directed toward the light collector to generate a light receiving signal corresponding to the amount of ambient light collected by the light collector; and

a control circuit connected to the liquid crystal display panel, the light receiving device, the light source, and the cover driving apparatus, wherein the control circuit controls an ON/OFF of the light source, the opening and closing of the cover, and adjusts the contrast ratio and the brightness in accordance with the light receiving signal, wherein the control circuit includes:

15 a judgment circuit for generating at least one of a contrast ratio adjustment signal, a brightness adjustment signal, a cover driving signal and an ON/OFF signal in accordance with the light receiving signal;

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a contrast ratio adjustment circuit connected to the judgment circuit, the contrast ratio adjustment circuit processing an image signal to adjust the contrast ratio in accordance with the contrast ratio adjustment signal; and

25 a brightness adjustment circuit connected to the contrast ratio adjustment circuit and the liquid crystal display panel, the brightness adjustment circuit processing the image signal, which contrast ratio has been adjusted, to adjust the brightness in accordance with the brightness adjustment signal, and wherein the judgment circuit includes:

30 a first judgment circuit for receiving the light receiving signal from the light receiving device and comparing the light receiving signal with a first criterion value to generate a contrast ratio adjustment signal;

a second judgment circuit for receiving the light receiving signal from the light receiving device and comparing the light receiving signal with a second criterion value to generate a brightness adjustment signal;

35 a third judgment circuit connected to the cover driving apparatus, the third judgment circuit receiving the light receiving signal from the light receiving device and comparing the light receiving with a third criterion value to generate a cover driving signal; and

40 a fourth judgment circuit connected to the light source, the fourth judgment circuit receiving the light receiving signal from the light receiving device and

comparing the light receiving signal with a fourth criterion value to generate an ON/OFF signal.

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23. (Previously Presented) A liquid crystal display apparatus comprising:

a liquid crystal display panel for displaying an image having a predetermined contrast ratio and brightness;

5 a luminescent unit arranged adjacent to the liquid crystal display panel, wherein the luminescent unit includes a light collector, which collects ambient light, a light source, and a cover, which opens and closes to selectively cover the light collector, wherein the collected ambient light is used as a backlight of the liquid crystal display panel;

a cover driving apparatus for opening and closing the cover;

10 a light receiving device substantially countering the ambient light directed toward the light collector to generate a light receiving signal corresponding to the amount of ambient light collected by the light collector; and

a control circuit connected to the liquid crystal display panel, the light receiving device, the light source, and the cover driving apparatus, wherein the control circuit
15 controls an ON/OFF of the light source, the opening and closing of the cover, and adjusts the contrast ratio and the brightness in accordance with the light receiving signal, wherein the control circuit includes:

a linear contrast ratio adjustment circuit for receiving the light receiving
signal and processing an image signal to adjust the contrast ratio in a linear manner in
20 accordance with the light receiving signal;

a linear brightness adjustment circuit connected to the linear contrast ratio
adjustment circuit and the liquid crystal display panel, the linear brightness adjustment
circuit receiving the light receiving signal from the light receiving device and processing
the image signal, which contrast ratio has been adjusted, to adjust the brightness in a
25 linear manner in accordance with the light receiving signal;

a first judgment circuit connected to the cover driving apparatus, the first
judgment circuit receiving the light receiving signal from the light receiving device and
comparing the light receiving signal with a first criterion value to generate a cover driving
signal; and

30 a second judgment circuit connected to the light source, the second
judgment circuit receiving the light receiving signal from the light receiving device and
comparing the light receiving signal with a second criterion value to generate an ON/OFF
signal.

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~~24.~~ (Previously Presented) A liquid crystal display apparatus comprising:

a liquid crystal display panel for displaying an image having a predetermined
contrast ratio and brightness;

a luminescent unit arranged adjacent to the liquid crystal display panel, wherein
5 the luminescent unit includes a light collector, which collects ambient light, a light
source, and a cover, which opens and closes to selectively cover the light collector,
wherein the collected ambient light is used as a backlight of the liquid crystal display
panel;

a cover driving apparatus for opening and closing the cover;

10 a light receiving device substantially countering the ambient light directed toward
the light collector to generate a light receiving signal corresponding to the amount of
ambient light collected by the light collector; and

a control circuit connected to the liquid crystal display panel, the light receiving
device, the light source, and the cover driving apparatus, wherein the control circuit
15 controls an ON/OFF of the light source, the opening and closing of the cover, and adjusts
the contrast ratio and the brightness in accordance with the light receiving signal, wherein
the control circuit includes:

an analog-to-digital converter connected to the light receiving device to
convert the light receiving signal to a digital light receiving signal;

20 a judgment circuit connected to the analog-to-digital converter, the cover
drive apparatus, and the light source, wherein the judgment circuit compares the digital
light receiving signal with a first criterion value to generate a contrast ratio adjustment
signal, compares the digital light receiving signal with a second criterion value to
generate a brightness adjustment signal, compares the digital light receiving signal with a

25 third criterion value to generate a cover driving signal, and compares the digital light receiving signal with a fourth criterion value to generate an ON/OFF signal;

a multiplier connected to the judgment circuit to multiply a digital image signal with the contrast ratio adjustment signal to adjust the contrast ratio thereof;

30 an adder-subtractor connected to the multiplier and the judgment circuit to perform summation and subtraction on the digital image signal, which contrast ratio has been adjusted, with the brightness adjustment signal to adjust the brightness;

a digital signal processing circuit connected to the adder-subtractor to perform a predetermined digital signal process on the digital image signal, which contrast ratio and brightness have been adjusted; and

35 a digital-to-analog converter connected between the digital signal processing circuit and the liquid crystal display panel to convert the processed digital image signal to an analog image signal.

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25. (Previously Presented) A liquid crystal display apparatus comprising:

a liquid crystal display panel for displaying an image having a predetermined contrast ratio and brightness;

5 a luminescent unit arranged adjacent to the liquid crystal display panel, wherein the luminescent unit includes a light collector, which collects ambient light, a light source, and a cover, which opens and closes to selectively cover the light collector,

wherein the collected ambient light is used as a backlight of the liquid crystal display panel;

a cover driving apparatus for opening and closing the cover;

10 a light receiving device substantially countering the ambient light directed toward the light collector to generate a light receiving signal corresponding to the amount of ambient light collected by the light collector; and

15 a control circuit connected to the liquid crystal display panel, the light receiving device, the light source, and the cover driving apparatus, wherein the control circuit controls an ON/OFF of the light source, the opening and closing of the cover, and adjusts the contrast ratio and the brightness in accordance with the light receiving signal, wherein the control circuit includes:

an analog-to-digital converter connected to the light receiving device to convert the light receiving signal to digital light receiving signal;

20 a multiplier connected to the analog-to-digital converter to multiply the digital image signal with the digital light receiving signal to adjust the contrast ratio thereof;

an adder-subtractor connected to the multiplier and the analog-to-digital converter to perform summation and subtraction on the digital image signal, which contrast ratio has been adjusted, with the digital light receiving signal to adjust the brightness; and

25 a judgment circuit connected to the analog-to-digital converter, the cover driving apparatus, and the light source, wherein the judgment circuit compares the digital light receiving signal with a first criterion value to generate a cover driving signal and

compares the digital light receiving signal with a second criterion value to generate an ON/OFF signal.

~~20~~ 26. (Previously Presented) A liquid crystal display apparatus comprising:

a liquid crystal display panel for displaying an image having a predetermined contrast ratio and brightness;

5 a luminescent unit arranged adjacent to the liquid crystal display panel, wherein the luminescent unit includes a light collector, which collects ambient light, a light source, and a cover, which opens and closes too selectively cover the light collector, wherein the collected ambient light is used as a backlight of the liquid crystal display panel;

a cover driving apparatus for opening and closing the cover;

10 a first light receiving device substantially countering the ambient light directed toward the light collector to generate a first light receiving signal corresponding to amount of ambient light collected by the light collector;

a second light receiving device for generating a second light receiving signal corresponding to a total amount of light illuminating the liquid crystal panel, which
15 includes the ambient light and the light of the light source; and

a control circuit connected to the liquid crystal display panel, the first and second light receiving devices, the light source, and the cover driving apparatus, wherein the control circuit controls an ON/OFF of the light source and the opening and closing of the

cover in accordance with the first light receiving signal, and adjusts the contrast ratio and
20 the brightness in accordance with the second light receiving signal.

~~21~~ 27. (Original) The apparatus according to claim ~~20~~ 26, wherein the control circuit
includes:

a judgment circuit for generating at least one of a contrast ratio adjustment signal,
a brightness adjustment signal, a cover driving signal and an ON/OFF signal in
5 accordance with at least one of the first and second light receiving signals;

a contrast ratio adjustment circuit connected to the first judgment circuit, the
contrast ratio adjustment circuit processing an image signal to adjust the contrast ratio of
the image signal in accordance with the contrast ratio adjustment signal; and

~~21~~ a brightness adjustment circuit connected to the contrast ratio adjustment circuit
10 and the liquid crystal display panel, the brightness adjustment circuit processing the
image signal, which contrast ratio has been adjusted, to adjust the brightness in
accordance with the brightness adjustment signal from the second judgment circuit.

~~22~~ 28. (Original) The apparatus according to claim ~~21~~ 27, wherein the judgment circuit
includes:

a first judgment circuit for receiving the second light receiving signal from the
second light receiving device and comparing the second light receiving signal with a first
5 criterion value to generate a contrast ratio adjustment signal;

a second judgment circuit for receiving the second light receiving signal from the second light receiving device and comparing the second light receiving signal with a second criterion value to generate a brightness adjustment signal;

10 a third judgment circuit connected to the cover driving apparatus, the third judgment circuit receiving the first light receiving signal from the first light receiving device and comparing the first light receiving signal with a third criterion value to generate a cover driving signal; and

15 a fourth judgment circuit connected to the light source, the fourth judgment circuit receiving the first light receiving signal from the first light receiving device and comparing the first light receiving signal with a fourth criterion value to generate an ON/OFF signal.

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29. (Original) The apparatus according to claim ²⁰~~26~~, wherein the control circuit includes:

5 a linear contrast ratio adjustment circuit for receiving the second light receiving signal from the second light receiving device and processing an image signal to adjust the contrast ratio in a linear manner in accordance with the second light receiving signal;

a linear brightness adjustment circuit connected to the linear contrast ratio adjustment circuit and the liquid crystal display panel, the linear brightness adjustment circuit receiving the second light receiving signal from the second light receiving device

and processing the image signal, which contrast ratio has been adjusted, to adjust the
10 brightness in a linear manner in accordance with the second light receiving signal;

a first judgment circuit connected to the cover driving apparatus, the first
judgment circuit receiving the first light receiving signal from the first light receiving
device and comparing the first light receiving signal with a first criterion value to
generate a cover driving signal; and

15 a second judgment circuit connected to the light source, the second judgment
circuit receiving the first light receiving signal from the first light receiving device and
comparing the first light receiving signal with a second criterion value to generate an
ON/OFF signal.

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~~30.~~ (Previously Presented) The apparatus according to claim ¹³~~17~~, wherein the
predetermined display characteristic includes transmittance, the control circuit changing
the minimum transmittance in accordance with the light amount signal.

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~~31.~~ (Previously Presented) The apparatus according to claim ¹³~~17~~, wherein the
predetermined display characteristic includes contrast ratio, the control circuit changing
the contrast ratio in accordance with the light amount signal.

32 - 34. (Canceled)

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